CLAIMS

1. A semiconductor structure comprising:

a monocrystalline silicon substrate ;

an amorphous oxide material overlying the monocrystalline silicon substrate ;

a monocrystalline perovskite oxide material overlying the amorphous oxide material ;

a monocrystalline compound semiconductor material overlying the monocrystalline perovskite oxide material; and

an arrayed wavelength grating device overlying the monocrystalline silicon substrate .

2. The semiconductor structure of claim 1, wherein:

the arrayed wavelength grating device functions as a multiplexer.

3. The semiconductor structure of claim 1, wherein:

the arrayed wavelength grating device functions as a demultiplexer.

4. The semiconductor structure of claim 1, wherein:

the arrayed wavelength grating device functions as a router.

5. The semiconductor structure of claim 1, wherein:

the arrayed wavelength grating device functions as a switch.

6. The semiconductor structure of claim 1, wherein:

a temperature sensitivity of the arrayed wavelength grating device is tunable.

7. The semiconductor structure of claim 1, wherein:

a polarization dependent wavelength of the arrayed wavelength grating device is tunable.

8. The semiconductor structure of claim 1, wherein:

a channel wavelength offset of the arrayed wavelength grating device is tunable.

9. The semiconductor structure of claim 1, wherein:

the arrayed wavelength grating device includes

a plurality of electro-optical waveguides formed within the monocrystalline compound semiconductor layer, each waveguide of the plurality of electro-optical waveguides carrying an optical signal of a distinct wavelength, and

a first electrode formed in the monocyrstalline compound semiconductor layer and above the plurality of electro-optical waveguides, the first electrode operable to provide a distinct phase shift to each waveguide of the plurality of electro-optical waveguides in response to an application of voltage to the first electrode.

10. The semiconductor structure of claim 9, wherein:

the arrayed wavelength grating device further includes

a planar waveguide region in optical communication with the plurality of electro-optical waveguides, and

a second electrode formed in the monocyrstalline compound semiconductor layer and above the planar waveguide region, the second electrode operable to tune a temperature sensitivity of the plurality of electro-optical waveguides.

11. The semiconductor structure of claim 9, wherein:

the arrayed wavelength grating device further includes

a planar waveguide region in optical communication with the plurality of electro-optical waveguides, and

a second electrode formed in the monocyrstalline compound semiconductor layer and above the planar waveguide region, the second electrode

operable to tune a polarization-dependent wavelength of the plurality of electro-optical waveguides.

12. The semiconductor structure of claim 9, wherein:

the arrayed wavelength grating device further includes

a planar waveguide region in optical communication with the plurality of electro-optical waveguides, and

a second electrode formed in the monocyrstalline compound semiconductor layer and above the planar waveguide region, the second electrode operable to tune a channel wavelength offset of the plurality of electro-optical waveguides.

13. A process for fabricating a semiconductor structure comprising:

providing a monocrystalline silicon substrate ;

depositing a monocrystalline perovskite oxide film overlying the monocrystalline silicon substrate , the film having a thickness less than a thickness of the material that would result in strain-induced defects;

forming an amorphous oxide interface layer containing at least silicon and oxygen at an interface between the monocrystalline perovskite oxide film and the monocrystalline silicon substrate;

epitaxially forming a monocrystalline compound semiconductor layer overlying the monocrystalline perovskite oxide film; and

forming an arrayed wavelength grating device overlying the monocrystalline silicon substrate .

14. The process of claim 13, wherein:

the arrayed wavelength grating device functions as a multiplexer.

15. The process of claim 13, wherein:

the arrayed wavelength grating device functions as a demultiplexer.

16. The process of claim 13, wherein:

the arrayed wavelength grating device functions as a router.

17. The process of claim 13, wherein:

the arrayed wavelength grating device functions as a switch.

18. The process of claim 13, wherein:

a temperature sensitivity of the arrayed wavelength grating device is tunable.

19. The process of claim 13, wherein:

a polarization dependent wavelength of the arrayed wavelength grating device is tunable.

20. The process of claim 13, wherein:

a channel wavelength offset of the arrayed wavelength grating device is tunable.

21. The process of claim 13, wherein the

the arrayed wavelength grating device includes

a plurality of electro-optical waveguides formed within the monocrystalline compound semiconductor layer, each waveguide of the plurality of electro-optical waveguides carrying an optical signal of a distinct wavelength, and

a first electrode formed in the monocyrstalline compound semiconductor layer and above the plurality of electro-optical waveguides, the first electrode operable to provide a distinct phase shift to each waveguide of the plurality of electro-optical waveguides in response to an application of voltage to the first electrode.

22. The process of claim 21, wherein:

the arrayed wavelength grating device further includes

a planar waveguide region in optical communication with the plurality of electro-optical waveguides, and

a second electrode formed in the monocyrstalline compound semiconductor layer and above the planar waveguide region, the second electrode operable to tune a temperature sensitivity of the plurality of electro-optical waveguides.

23. The process of claim 21, wherein:

the arrayed wavelength grating device further includes

a planar waveguide region in optical communication with the plurality of electro-optical waveguides, and

a second electrode formed in the monocyrstalline compound semiconductor layer and above the planar waveguide region, the second electrode

operable to tune a polarization-dependent wavelength of the plurality of electro-optical waveguides.

24. The process of claim 21, wherein:

the arrayed wavelength grating device further includes

a planar waveguide region in optical communication with the plurality of electro-optical waveguides, and

a second electrode formed in the monocyrstalline compound semiconductor layer and above the planar waveguide region, the second electrode operable to tune a channel wavelength offset of the plurality of electro-optical waveguides.